C-2.1 Illustrate electron configurations by using orbital notation for representative elements

Revised Taxonomy Level 2.2-B <u>Exemplify</u> (<u>illustrate</u>) conceptual knowledge

In Physical Science, Students

- Compare the subatomic particles (protons, neutrons, and electrons) on an atom with regard to mass, location, and charge, and explain how these particles affect the properties of an atom (including identity, mass, volume, and reactivity). (PS-2.1)
  - The electron cloud is the space where electrons are moving erratically in regions of space called energy levels
    - Energy levels are regions of space at increasing distances from the nucleus
    - There is a maximum number of electrons that can occupy each energy level and that number increases the further the energy level is from the nucleus

    (Students did not address quantum numbers in physical science)
- Explain the trends of the periodic table based on the elements' valence electrons and atomic numbers. (PS-2.3)
  - Determine how many energy levels are occupied in a given element by recognizing that the period in which an element appears on the periodic table indicates the number of occupied energy levels.
  - Determine the number of valence electrons for selected groups of elements (groups 1,2,13,14,15,16,17,18) when given the element's group number or name

    (Students have not been introduced to electron orbital notation)

It is essential for students to

- Understand that the representative elements are those elements within the first two groups (groups I and II on the far left) and the last six groups on the right of the Periodic Table.
- Understand the first two quantum numbers and use them to describe the location of electrons in representative elements in the ground state
  - Principle quantum number
    - Understand the aspect of electron location described by the principle quantum number. (Energy level)
    - Understand that the principle quantum number is designated by numbers 1 through 6 and understand the meaning of each of those numbers in reference to the location of the electron.
  - Orbital quantum number
    - Understand the aspect of electron location described by the orbital quantum number. (Type of orbital)
    - Understand that the orbital quantum number is designated by one of four letters (s,p,d,f) and understand the meaning of each of those letters in reference to the location of the electron
    - Understand how many of each type of orbital are possible in each of the 6 energy levels.
    - Understand that two electrons can occupy each orbital

- Use standard orbital notation to illustrate the electron configuration of a representative element in the first three periods based on the element's position on the periodic table.

Orbital Notation for Oxygen:

  - Additional methods of illustrating electron configuration include
    - Electron configuration notation
      For oxygen: $1s^2 2s^2 2p^4$

    - Electron Dot notation (to show valence electrons)
      Electron Dot Notation or Selenium:

: Se :

Tradition Chemistry differentiation

- Understand the last two quantum numbers and use them to describe the location of electrons in representative elements in the ground state
  - Magnetic quantum number
    - Understand what aspect of electron location this describes.
    - Understand that it is designated by one of 7 numbers and understand what each of those numbers mean in reference to the location of the electron.
  - Spin quantum number
    - Understand what aspect of electron location this describes.
    - Understand that it is designated by numbers a positive (+) or a negative (-)
    - Understand that two electrons occupying the same orbital must have opposite spins
  - Understand that no two electrons in an atom can the same set of quantum numbers
- Illustrate the electron configuration for all elements on the periodic table,
  - Understand that the order in which electrons fill orbitals reflect the most stable electron arrangement for the given number of electrons.
    - Students should be able to make general statements concerning stable electron arrangements
      - All "d" orbitals are less stable than the "s" orbitals in the next-highest energy level
      - All "f" orbitals are less stable than the "s" and the "p" orbitals which are two energy levels higher, and less stable than the "d" orbitals which are one energy level higher
- Understand exceptions to the normal orbital filling order (Cr, Mo, Cu, Ag, Au)
  - What the exceptions are
  - Why they are exceptions
- Use a Bohr model of the atom to explain the bright line spectrum in terms of electrons moving between energy levels

Assessment

The verb exemplify (illustrate) means to find a specific example or illustration of a concept or principle, therefore the major focus of assessment will be for students to give examples that show that they understand stable electron arrangement of representative elements in the ground state. Conceptual knowledge requires that students understand the interrelationships among the basic elements within a larger structure that enable them to function together. In this case, that students understand the characteristics of the quantum numbers and can use those characteristics to predict the stable electron arrangement of elements. Because students must demonstrate conceptual knowledge, assessments should require that students justify why their examples meet the above criteria.